Intercalibration of AIRS and CrIS via SNOs, PDFs, and Large Random Samplings

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October 24, 2017

Understanding L1b Differences between AIRS and CrIS

Outline

- SNOs
- Large statistical intercomparisons

Prerequisites

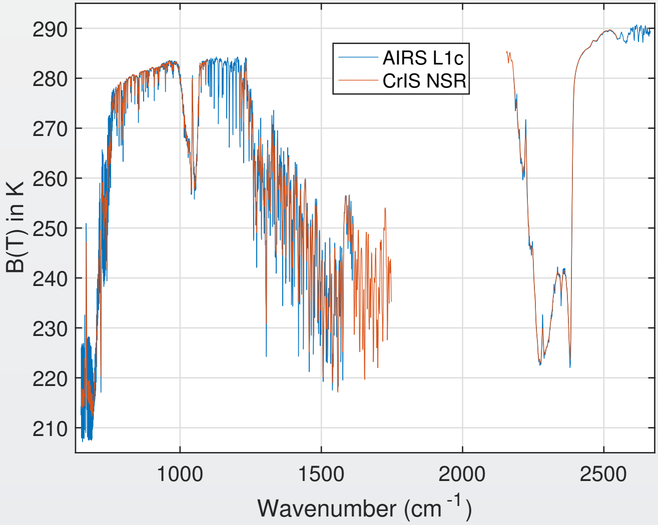
- L1c
- AIRS2CrIS (Howard Motteler's previous talk)
- Sampling strategies
- L1b/L1c Q/C (for extremes)

Approach

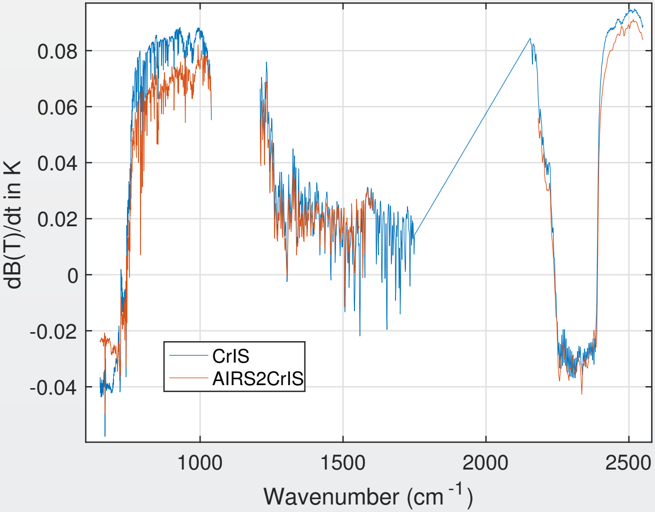
- SNOs
  - 20 km, 20 min (somewhat relaxed)
  - Convert AIRS L1c to CrIS (AIRS2CrIS) for comparison
- Statistical Comparisons
  - Nadir subset (1% of data)
  - Full sampling (all scenes) for 900 and 2550 cm^{-1} data
  - Separate land and ocean

CrIS vs AIRS L1c Spectra

20 Deg. Zonal Average of near nadir scenes

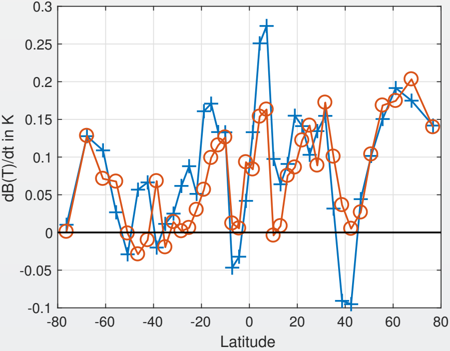


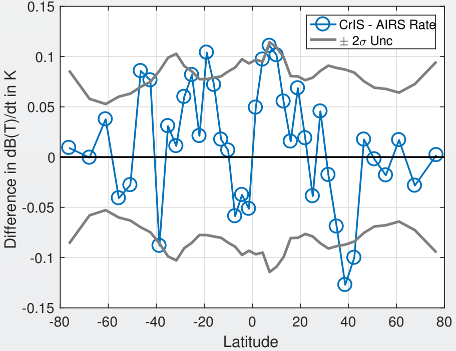
CrIS and AIRS are Stable: Capture Same Trends



Here AIRS L1c converted to CrIS ILS

AIRS and CrIS 5-Year Trends Agree within Uncertainty





This just shows that our AIRS - CrIS differences are within estimated uncertainties.

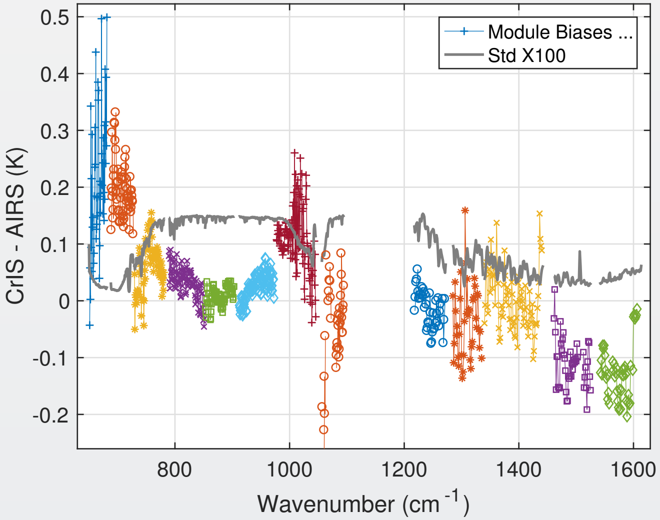
Connecting AIRS and CrIS: Radiometric

Intercalibration Issues

Previous Issues

- UMBC and JPL used "AIRXBCAL" like data: random nadir subsets
- These do not provide good enough sampling for statistical intercomparisons (mostly due to time differences in scene sampling)
- *This Work:* CrIS Q/A based on imaginary radiance values too severe, we only limit min radiance (3 values for LW/MW/SW)
- *This Work:* Full all-scan sampling (every scene, yearly statistics!)

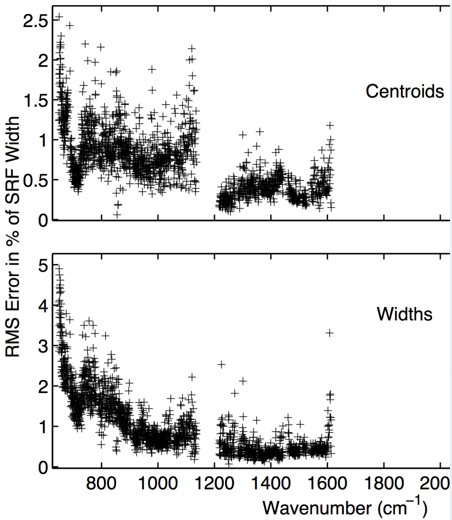
SNO differences by AIRS Module (1-Year of SNOs)



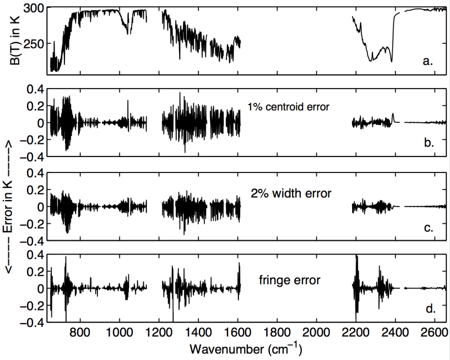
AIRS2CrIS shown. Statistical errors very small. Small scale variability likely AIRS ILS uncertainties!

Use SNOs to Improve AIRS Longwave ILS?

AIRS TVAC ILS Uncertainties

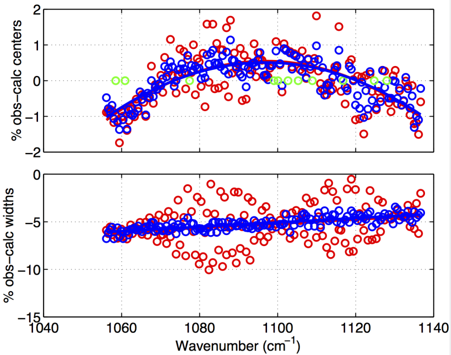


AIRS Sensitivity to ILS Errors

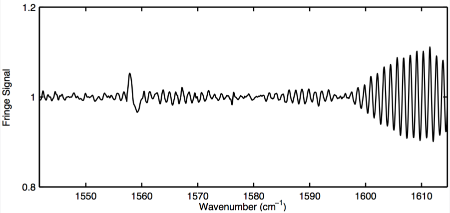


AIRS Entrance Filter Fringe Effects

Our Least Favorite Array

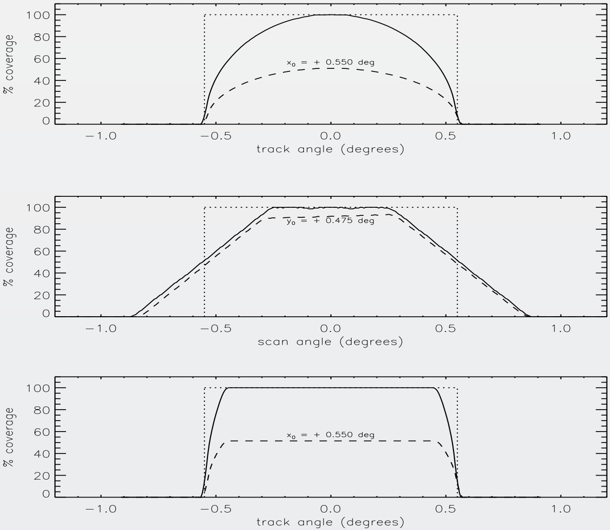


Fringes in H_2O ν_2 Band Center (good sounding region)



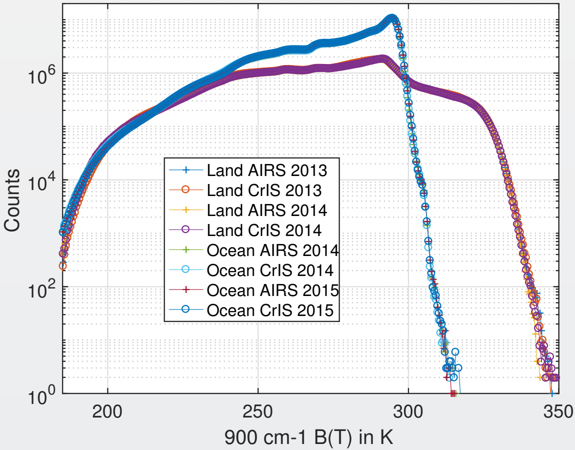
Extrema and Spatial Differences

AIRS Spatial Footprint vs CrIS (Work by Chris Barnet)



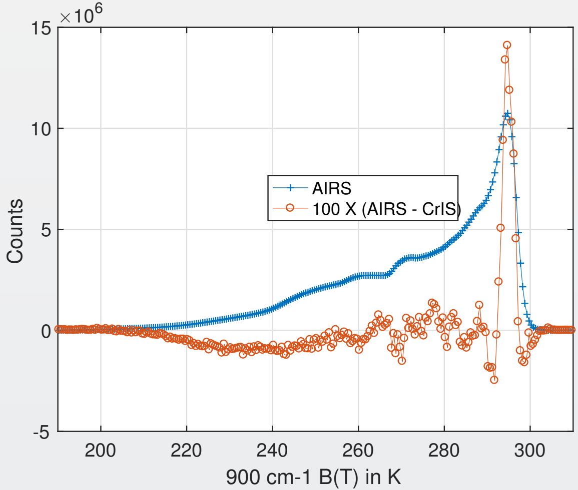
AIRS spatial response is broader, significant impact for cloud response (and cloud-clearing), extrema detection

Longwave Count Histograms (700 Million per Year)



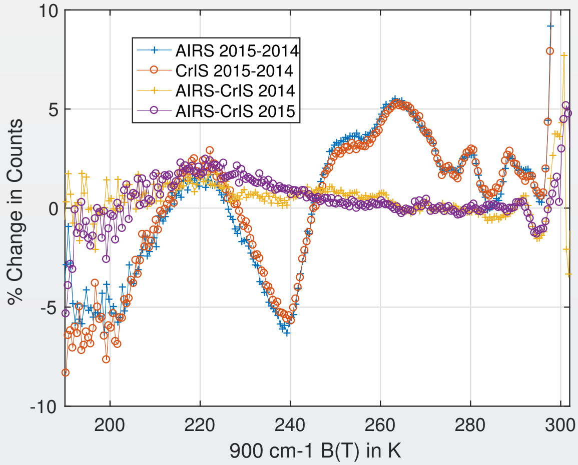
Note land counts only agree with change in CrIS Q/C

Longwave Ocean Count Differences (due to spatial diffs?)



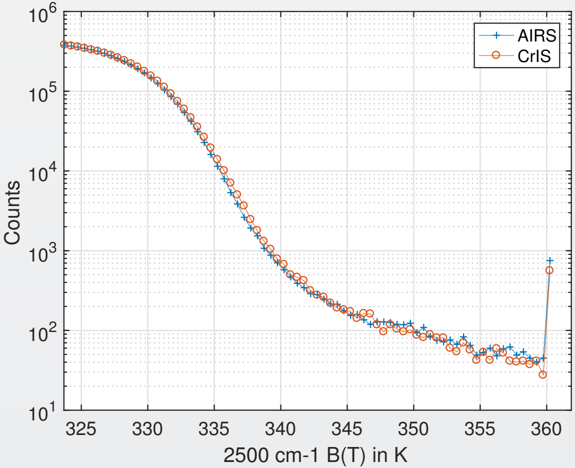
AIRS FOV is slightly smeared relative to the CrIS FOV.

Variability in Longwave Counts (Ocean Only)



Percentage differences in counts vary much more with year than between instruments.

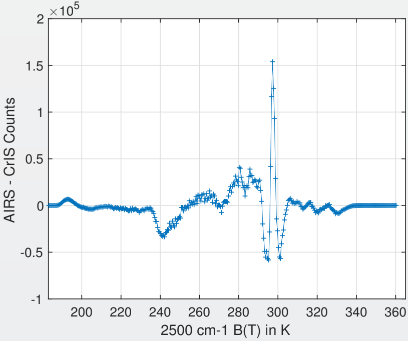
Hot Scene Shortwave Histograms (solar reflection off clouds)



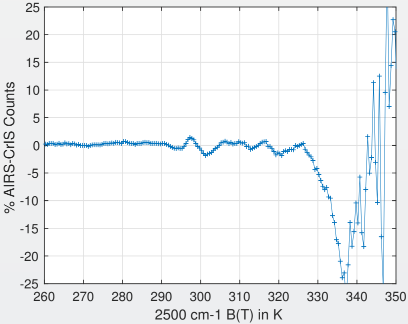
CrIS stopped far below max before change in CrIS Q/C. This is a remarkable result!

Global Shortwave AIRS vs CrIS Observations

Absolute Count Differences



Percentage Difference in Counts



Final Thoughts

- FOV spatial have an impact on radiometric differences.
- Small, but possibly important, especially for cloud-clearing!
- Less important for single-footprint retrievals

Conclusions

- SNOs provide radiometric offsets between AIRS2CrIS and AIRS
- All-scene Channel PDFs indicate excellent agreement for hot scenes *if* remove imaginary radiance Q/C
- Slight differences in colder scene histogram, spatial issue?
- CrIS sees more clear scenes (in ocean testing), changes cloud-cleared statistics (Aumann: 8% more variability FOV to FOV)
- Simulation confirms AIRS FOV wings can lower hot histogram counts (not shown)

UMBC: Next Steps

- Re-do AIRXBCAL (and CrIS) random subsetting to use all scan angles
- Determine if small ILS modifications within TVAC uncertainties can improve AIRS2CrIS vs CrIS SNO differences
- Test climate level trends and anomalies between AIRS and AIRS2CrIS
  - Create 10-year AIRS T/Q trends based on radiance trends
  - Create 5-year AIRS + 5-Year CrIS radiance product and then compare T/Q trends from this product to the AIRS-only product
- Continue histogram counts studies to more opaque channels, hopefully find even smaller differences